AN AMUSEMENT MACHINE

Field of the Invention

This invention relates to an amusement machine, in particular to a coin operated amusement machine.

Summary of the Invention

According to one aspect of the present invention, there is provided a coin projection device comprising a coin entry which leads to a coin validation unit, coins validated by the coin validation unit passing to a coin stack holder, coin ejection means being provided for pushing the bottom coin in the stack onto a coin projection runway, the machine further comprising a firing mechanism for striking the edge of a coin on the runway to drive the coin along the runway thereby to project the coin.

This aspect of the invention thus enables a stack of validated coins to be formed, with individual coins being fed to a runway for projection onto a surface, such as a playfield constituting a part of an amusement machine.

Preferably, the validation unit is provided with a first sensor for detecting whether a coin has been entered, and the runway is provided with a second sensor for detecting whether a coin is present on the runway, the coin ejection means being controlled automatically in dependence on the signals of the first and

second sensors. In this way, the feed of coins onto the runway by the ejection means is automated, so that the user simply controls the firing of the coins along the runway.

The ejection means may comprise a platform for supporting the coin stack, wherein the platform is slidable between a first position in which the coin stack is supported on the platform and a second position in which the coin stack is supported on a further, lower platform, and when the platform passes from the first position to the second position, the coin stack drops to the lower platform, and when the platform passes from the second position to the first position the lowest coin in the stack is pushed by the platform onto the coin projection runway. This arrangement provides a simple structure for feeding individual coins to the runway.

The firing mechanism may comprise a hammer for striking an edge of the coin which overhangs the end of the runway, the hammer being drawn back manually against the action of a spring and being subsequently released to strike the coin. The hammer can preferably be retained in one of a plurality of possible drawn back positions by a ratchet mechanism, the ratchet mechanism being released to release the hammer.

The invention also provides a coin-operated machine comprising a plurality of coin projection devices of the invention with a single manual control for drawing back and releasing the hammers of each machine simultaneously. The machine

preferably has two coin projection devices. The machine may be combined with a segmented playing surface to define an arcade-type game.

According to another aspect of the present invention, there is provided a coin magazine for a coin projection device, the coin magazine comprising a coin holder for holding a stack of coins and a platform for supporting the coin stack, wherein the platform is slidable between a first position in which the coin stack is supported on the platform and a second position in which the coin stack is supported on a further, lower platform, and when the platform passes from the first position to the second position, the coin stack drops to the lower platform, and when the platform passes from the second position to the first position the lowest coin in the stack is pushed by the platform into a firing position.

This aspect of the invention also provides a means for enabling a stack of coins to be formed, wherein individual coins are fed onto a runway for projection.

According to a further aspect of the present invention there is provided an article holding apparatus including means for clearing articles therefrom, the apparatus comprising a surface for supporting an array of articles; at least one aperture in the surface through which articles can pass; and a sweeper arm in sliding contact with the surface, whereby relative movement between the surface and the sweeper arm causes the sweeper arm to sweep at least part of the surface, and the sweeper arm having at least one U- or V-shaped indentation in its leading surface relative to sweeping movement, the indentation having an apex which is located so as to

pass directly over one or more of the apertures in the surface, whereby the relative movement between the sweeper arm and the surface causes articles on the surface to be swept both in the sweeping direction and transversely to the sweeping direction, towards the apex of the indentation, where the articles are held until the apex passes over an aperture, whereupon the articles pass through the aperture.

This aspect of the invention thus provides an effective method of clearing playing pieces, such as coins, on a moving surface such as a playfield constituting part of an amusement machine. The term "coin" used herein is intended to include tokens and other similar articles.

The relative movement between the surface and the sweeper arm may be achieved by a combination of a movable playfield with a static sweeper arm, or a static playfield with a movable sweeper arm, or both the playfield and the sweeper arm may be movable. In one embodiment, the surface is comprised by a rotatable circular playfield, with at least two, preferably four, equally spaced radial sweeper arms.

According to yet a further aspect of the present invention there is provided an article holding apparatus comprises a surface defining a target field having an array of target areas at positions on the target field and a position encoder having a number of sensors, the target field and the or each sensor being adapted for relative movement to one another so that articles introduced onto the target field

can be detected by a sensor, wherein the position encoder maintains a cyclical count and is arranged to determine whether or not an article detected by a sensor is within a target area on the target field with reference to a count value held by a counter.

This aspect of the invention provides an accurate way of determining the position of articles, such as coins or tokens, on target areas forming part of a playfield of an amusement machine such that a "win" occurs when a coin is detected on the target area. Legal requirements dictate that wins must be properly recognised before a machine will be issued with the necessary gaming licence.

Preferably, the position encoder comprises a microprocessor which maintains the count and has an associated memory device which stores a look-up table for mapping count values to target field position for use in determining whether or not an article detected by a sensor falls within one of the target areas on the target field.

Preferably, the or each sensor is associated with at least one dedicated look-up table which defines the circumferential limits of each target area capable of passing within the detection field of the sensor with respect to count value.

Preferably, the microprocessor is arranged to apply a correction factor when determining the position of an article on the target field with reference to a look-up table to compensate for any variation in the speed of the relative movement

between the target field and the or each sensor over time.

Preferably, the position encoder counter is reset periodically in dependence on the relative positions of the target field and the or each sensor.

Preferably, the or each sensor is an inductive field-type sensor.

The relative movement between the surface and the or each sensor may be achieved by a combination of a movable playfield with one or more static sensors, or a static playfield with one or more movable sensors. Alternatively, the playfield and the or each sensor may be movable. In one preferred embodiment, the surface comprises a rotatable horizontal playfield with at least two radially spaced sensors. Preferably, there are at least two, and more preferably four, equally circumferentially spaced sets of radially spaced sensors.

In a preferred embodiment of the present invention an the amusement machine includes a horizontal playfield divided into four quadrants each with target areas which represent zones onto which a person must aim to project playing pieces, using a coin projection device in order to win. Playing pieces such as coins or tokens may be used. The win value is determined with respect to a stored set of game rules. The playing pieces are then cleared using a fixed device (sweeper arm) which floats on the surface of the playfield. The device catches the playing pieces and contains them until an aperture in the playfield passes under the device. The playing pieces then fall through the aperture into a chute, and are

delivered to a receptacle under the playfield. The amusement machine also includes a position encoder which provides an accurate way of determining the positions of coins or tokens lying on the playfield, where legal requirements dictate that wins must be properly recognised before a machine will be issued with the necessary gaming licence.

Brief Description of the Invention

Examples of the present invention will now be described with reference to the accompanying drawings, in which:

Figure 1 is an example of an amusement machine in accordance with the present invention;

Figure 2 is a simplified schematic view of a target field for an amusement machine having an array of target areas;

Figure 3 is a plan view of a sweeper arm;

Figure 4 is a block diagram of a game control system associated with a position encoder used to determine the position of articles introduced onto the target field of Figure 2;

Figure 5 is an exploded view of the components of a coin-operated machine having two projection devices of the invention;

Figure 6 shows in greater detail the slider mechanism incorporated in the projection device of Figure 5; and,

Figure 7 shows in greater detail the firing mechanism incorporated in the projection devices of Figure 5.

Detailed Description

Figure 1 shows an amusement machine 1 with a playfield 2 divided into four quadrants, each quadrant being provided with a coin projection device 3. In use, a player must aim to project playing pieces onto the playfield using a coin projection device 3. Coins are cleared by a sweeper arm (see figure 2) and the position of the coins on the playfield are detected by a coin position encoder (see figure 2) to determine whether or not the player wins a payout in accordance with the rules of the game. The present invention concerns not only the amusement machine itself but also elements of the machine described in detail with reference to Figures 2 to 7 of the accompanying drawings.

Figure 2 shows a circular playfield 2 suitable for use in the machine of Figure 1 which rotates in the direction shown by the arrow A. The playfield 2 has an array of marked target areas 3, which form a part of the game associated with the amusement machine 1. In the course of the game, coins are projected onto the playfield 2. Some of the target areas have apertures 4 which are machined into the playfield. The target areas are spaced along four different circular tracks on the playfield.

A fixed metal chassis 5 is positioned above the playfield and divides the playfield into four equal quadrants. The chassis 5 supports four equally spaced radial sweeper arms 6. The chassis 5 floats immediately above the playfield by means of fixings in the centre and circumference of the playfield, thus allowing the playfield to rotate freely. Fixed to each limb of the chassis is a sweeper arm 6

made of a machined block of self-lubricating material, such as oil filled nylon. As shown in Figure 3, this block is shaped to form four U- or V-shaped indentations 7 in the leading surface (with respect to relative movement between the playfield 2 and chassis 5). The indentations are positioned such that the apexes 8 pass directly over respective apertures 4 in the playfield. Thus, the apexes of the four indentations correspond respectively to the four circular tracks along which the target areas (and apertures) are positioned. Each indentation has a shallow sloping side 9 closer to the centre of the playfield, and a steeper sloping side 10 further from the centre of the playfield. Together with the rotary movement of the playfield, this helps to direct the coins towards the apex. Coins on the playfield are thus swept by the movement of the playfield into the indentations until they reach the apex, and the coins then fall through the apertures as the apex passes over the apertures. Each circular track has one aperture in each of the four quadrants. Coins on the playfield are thus cleared. Sensors 11, such as inductive field-type sensors, are attached to the chassis 5 so as to sense coins and provide a signal to a game control system shown in Figure 4.

The apparatus includes an optical sensor 12 on one arm which is positioned to detect each of four equally circumferentially spaced marks 13 provided on the edge of the playfield 2 as they pass by the optical sensor 12 and output a signal to the control system shown in Figure 4.

In a modification of the apparatus described above, the sweeper arm can be made

of a metal casting, and provided with wheels on its surface adjacent the playfield surface. Provided the clearance between the two surfaces is small enough, coins can still be swept effectively, and the wheels reduce wear of the two surfaces.

The game control system shown in Figure 4 is centred around a microprocessor 14 having an associated memory store 15. Any form of processor is suitable. The memory store 15 holds computer executable instructions for operating the amusement machine together with a number of look-up tables used in determining the position of the coin on the playfield, and in particular, whether or not a detected coin lies within one of the marked target areas. Microprocessor 14 receives signals from each of the four induction sensors 11 provided on each of the four arms 6 of the chassis 5 together with signals from the optical sensor 12. The microprocessor 14 maintains an internal counter which is reset periodically in dependence on the output of the optical sensor 12. The microprocessor 14 is also associated with a coin entry validation unit 16, a game display 17, and a payout dispensing unit 18.

In use, coins which are projected onto a quadrant of the playfield 2 are detected by one of the sensors 11 on the respective arm 6 of the chassis 5. As the leading edge of the coin passes into the detection envelope of a sensor 11 the sensor outputs a logic low value and maintains this until the trailing edge of the coin passes outside the detection envelope. The microprocessor 14 is arranged to detect the rising edge of the pulse generated by the sensor 11 and record the current count value held by the internal counter maintained by the

microprocessor. In order to determine whether or not the detected coin is within a winning target area, the microprocessor 14 accesses a look-up table held in the memory store 15 to check if the count value falls within the limits of one of the possible target areas on the circular band associated with the sensor. If it does, then a win is recorded, the value being determined with reference to the particular target area identified by the look-up table. In this example, there are four different look-up tables, one for each band of the playfield, defining the target areas in each band.

In this example, the playfield 2 is assumed to take a count of 3150 interrupts of the microprocessor clock cycle to rotate through 90° i.e. one complete quadrant. Whilst in some circumstances it may be acceptable to map the count value directly to the corresponding entry in the appropriate look-up table when a coin is detected, this is not the case when used in gaming machines, since variations in the rotational speed of the playfield (which is independent of the microprocessor interrupt cycle) can give rise to errors. In the present invention, these errors can be compensated for by applying a speed correction factor which takes into account the average rotational speed of the playfield 2.

In the game control system shown in Figure 4, the count maintained by the microprocessor 14 is only reset when the microprocessor detects an output from the optical sensor 12. Variations in rotational speed mean that a count value may be less than or greater than 3150 at the time of reset. If the count value exceeds a predetermined maximum value (say 4000), the machine enters an alarm mode

and the game stops.

To correctly map the count value recorded when a coin is detected to the correct position in the look-up table, a logic algorithm is applied by the microprocessor so that a win is detected when the following is satisfied:

IF (count_value $\geq$ (start_bit x (average_count/3150))

AND (count_value $\leq$ (stop_bit x (average_count/3150))

where:

count-value is the current count value on the playfield at the time the coin is detected;

start_bit and stop_bit are values in the look-up table defining the circumferential limits of a winning target area identified in the look-up table with respect to the direction of rotation of the playfield;

average_count is the average number of counts taken to traverse each quadrant; and

3150 is the length of the look-up table.

An example of look-up table having seven target areas is shown below in Table 1.

Table 1

#define r1_b1_st	0.0
#define r1_b1_stp	0.0
#define r1_b2_st	426.0
#define r1_b2_stp	656.0
#define r1_b3_st	879.0
#define r1_b3_stp	1108.0
#define r1_b4_st	1331.0
#define r1_b4_stp	1562.0
#define r1_b5_st	1785.0
#define r1_b5_stp	2015.0
#define r1_b6_st	2239.0
#define r1_b6_stp	2468.0
#define r1_b7_st	2962.0
#define r1_b7_stp	2921.0

The present invention provides an accurate position encoder for determining the position of coins or tokens on the playfield. Indeed, the resolution at the innermost band of target areas is around 0.15 mm whilst the resolution at the outermost band of target areas only reduces to a figure of around 0.29 mm, each of which is sufficient to meet the requirements of the various gaming laws found

Internationally.

Figure 5 shows a coin projection device 3, for example for use in an amusement arcade game of the type described above.

In general terms, the invention provides a coin projection device comprising a coin entry 19 which leads to a coin validation unit 20. Coins validated by the coin validation unit are passed to a coin stack holder 21, coin ejection means being provided for pushing the bottom coin in the stack onto a coin projection runway. The machine has a firing mechanism for striking a coin on the runway to drive the coin along the runway thereby to project the coin.

In more detail, the machine shown in Figure 5 essentially comprises two functionally identical (but symmetrically inverted) coin projection devices as described above, arranged side-by-side, with a single manual control 25 for operating the two devices simultaneously. The two devices are housed in a single housing comprising a top casing part 26 and a lower cradle 27. The two devices illustrated in Figure 6 are shown exploded to different degrees, for the purposes of clarity.

The machine is provided with two coin entry slots 19, each of which leads to a respective coin validation unit, in the form of a coin comparator 20. This is a standard item widely used in the amusement and vending industry to validate all types of coins and tokens. In general, two paths are provided for the coins, one

path for validated coins and a reject chute 29 for rejected coins.

In the apparatus of Figure 5, the validated coins pass into a coin tube 21, which can hold a given number of validated coins. The entered coins are rotated between the slot 19 (which requires upright coins) and the coin tube 21 (which stacks the coins flat) as they travel down a coin chute. The coin tube can contain a stack of validated coins. The coin stack is positionally fixed by a coin tube holder 30, and the coins in the stack rest on one of two support platforms.

A first support platform is in the form of a slider mechanism 22 which is slidable between a first position in which the coin stack is supported on the slider mechanism 22 and a second position in which the slider mechanism is displaced laterally away from the coin stack. In this second position, the coin stack is supported on a second, lower platform 31.

The movement of the slider mechanism between the two positions is controlled by a solenoid 32, the central moveable core of which is coupled to the slider mechanism by a link arm arrangement 33. This is shown in greater detail in assembled form in Figure 6.

The thickness of the first platform is slightly less than the thickness of a valid coin, and the first platform is provided directly over the second platform 31. When the first platform passes from the first position to the second position, the coins in the stack drop to the second platform. When the first platform passes

back from the second position to the first position, it pushes out only the lowest coin in the stack, and the remainder of the stack is then supported once again on the first platform.

The coin which is pushed out passes through a slot 34 and lands on a runway in the form of a coin ramp 35. The coin lands on the coin ramp 35 in such a position that a portion of the edge of the coin overhangs the end of the ramp 35. A sensor 36 is associated with the ramp for detecting whether or not a coin is in position at the end of the ramp. This sensor may comprises a pressure sensor or a light source and detector arrangement for detecting light reflected by the coin, when present. The ramp 35 presents a slight incline, so that a coin driven along the ramp will be elevated.

A hammer 38 is provided for striking the edge of the coin to project the coin along the ramp 35. The ramp may have an end deflector part 38 arranged at an angle to the main part of the ramp 35, to give the projected coin additional elevation, and/or to impart a tossing motion to the coin and to control the direction of the coin.

The hammer 38 is drawn back under the control of a manual handle 25 against the bias of a torsion spring 39. The lever is mounted on bearings 40 provided on support plates 41 on either side of the handle 25. As will be explained in greater detail with reference to Figure 7, a ratchet mechanism is provided to give a number of different power settings for the hammer action. In an alternative

arrangement a tension spring may be fixed to the handle 25 so that the handle is spring loaded (not shown).

A solenoid control board 42 is mounted on the cradle 27 for automatic control of the solenoid 32, which in turn effects the loading of the bottom coin in the coin stack onto the ramp 35. The signals from the ramp sensor 36 and the sensor in the coin comparator 20 are supplied to a main control unit (not shown), which has appropriate software to generate command signals which are supplied to the control board 42 for driving the solenoid 32.

The control is such that the solenoid will be actuated to load a coin onto the ramp 35 from the bottom of the stack, provided there is a coin in the stack (as determined by the comparator sensor) and as soon as a coin has been projected off the ramp (as detected by ramp sensor 36). The comparator sensor is arranged to count the number of validations, and derive from this the number of coins in the stack depending upon the number of times the solenoid has been activated. In the latter case, the sensor comprises a latch which is triggered each time a validated coin passes through the comparator. The solenoid may then be actuated an equal number of times to the number of validations, to ensure that all valid coins have been projected.

Figure 6 shows the arrangement for providing coins to the ramp in greater detail, and in assembled form. As shown, the solenoid 32 includes a central slidable core 43 which is coupled by the link arm 33 to the slider 22. The slider 22 has

a downward projection 44 which extends through a slot 45 in the lower platform 46 (shown in Figure 5), and the projection 44 passes between two pins 47 of the link arm 33 so that the link arm 33 can drive the platform in both directions.

The movement of the slider 22 away from the coin stack is under the control of the solenoid 32, but the return is under the control of a return spring 49. Thus, in the normal idle state of the machine, with the coin stack supported on the slider 22, no solenoid control signal is needed. In an alternative arrangement, the return action may be provided by a conical spring fixed to the core 43 itself (not shown).

Figure 7 shows in greater detail the handle assembly. The handle can be drawn back to a limited extent as dictated by a stop bar 51 having a rubber cover. As the handle is drawn back (i.e. rotated clockwise in Figure 8), a ratchet 52 is caused to move past a latch 53 by means of a linkage 54. The latch 53 is sprung anticlockwise in Figure 7 so that the ratchet is retained in the drawn back position, against the bias of the torsion spring . The hammer 37 is coupled to the ratchet 52.

In the example shown in Figure 7, four ratchet positions are provided. To release the hammer 37, the latch 53 must be lifted to disengage the ratchet. This can be achieved manually by returning the handle to the position shown in Figure 7, in which a lip 54 lifts the latch 53.

Thus, as the handle is drawn back, the ratchet clicks corresponding to an increase in the hammer power. Once the desired number of clicks has been heard (from 1 to 4 for the Figure 7 embodiment), the handle is returned to the starting position to release the hammer.

The exact nature of the games in which the projection device and article holding apparatus of the present invention may be employed has not been described in detail, since numerous possibilities will be apparent to those skilled in the art. Furthermore, various modifications to the specific implementation of the coin projecting device and article holding apparatus described will be apparent.